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AN INFECTION WITH THE PARATYPHOID BACILLUS (B. PARATYPHOSUS B) *

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The case here reported has afforded a somewhat unusual opportunity for a complete clinical and bacteriologic study of an infection with the paratyphoid bacillus. An acute infection led to the condition of chronic paratyphoid carrier, associated with recurrent attacks of cholecystitis that finally necessitated drainage of the gall-bladder, with subsequent disappearance of paratyphoid bacilli from the stools. The report follows:

Miss Y. Z., 23 years old. Family history shows nothing of note; previous illnesses were measles, chicken pox, pertussis, in childhood. She had never had typhoid fever. In 1906, after repeated attacks of pain in the abdomen, the appendix was removed with relief of symptoms. In 1911, she had an attack of pain in the right ankle which was diagnosed "rheumatism." Otherwise health had been good and patient had been able to attend to her duties as a nurse. On October 11, 1912, the patient entered the Presbyterian Hospital, in the service of Dr. J. B. Herrick, suffering from severe, spasmodic pain in the right hypochondrium, accompanied by nausea, vomiting, and fever. This was the fourth of a series of attacks during the previous five weeks, all of which were of similar character, sudden in onset and usually associated with fever, varying only in severity. Periods of apparently good health intervened. There was no previous trouble referable to the stomach, and all attacks came on without any demonstrable relation to the taking of food. Since the last attack two weeks before, the patient thought that possibly she had had fever; she had felt ill, tired, and had had a poor appetite.

She was a well-nourished young woman, apathetic, except when roused by a paroxysm of pain in the abdomen. The region of hypochondrium was extremely tender, with a less degree of tenderness over the remaining upper abdomen. There was no general rigidity. Temperature was 101 F.; pulse 108; respirations 24. A complete physical examination revealed no other abnormalities of note.

Blood: Leukocytes 14,000; hemoglobin 85 percent (Dare).

Urine: Clear, amber, acid, containing no albumin, sugar, casts, or pus.

Stool: Yellowish brown, showing no blood or other abnormalities. Five subsequent examinations of the stools showed traces of blood by the Weber test (menstruation in progress).

Oct. 13.—During previous two days, temperature remained between 100 and 102 F. Repeated vomiting of greenish fluid containing faint traces of blood.

Blood: Leukocytes 10,700; hemoglobin 90 percent (Dare).

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Oct. 15.—Temperature rose steadily and for twenty-four hours varied between 103 and 105 F. Pulse 110-115. Blood culture made.

Blood: Leukocytes 8,200. A count of 200 cells gave 87.5 percent polymorphonuclears; 12.5 percent mononuclears.

Oct. 16.—Leukocytes 6,200; polymorphonuclears 80 percent; mononuclears 20 percent. Urine: Cloudy, 1.017, albumin trace, no sugar, acetone present, no diacetic, many hyaline and granular casts, a few leukocytes and red cells.

Stool: Brown, liquid, Weber positive, no amebae.

Oct. 17.—Leukocytes 8,300. Polymorphonuclears 87.5 percent; mononuclears 12.5 percent.

Urine: Albumin increased; large numbers of hyaline, granular, and epithelial casts together with red cells and leukocytes.

Slight abdominal tenderness still present. The appearance is more suggestive of typhoid fever. Lips, dry; a slight sore throat; pulse, dicrotic. The temperature remained high, varying between 103 and 105 F. The blood culture in broth showed a motile, gram-negative bacillus. Agglutination with B. typhosus negative at 1:20 and 1:40, in one hour.

Oct. 18.—Suspicious rose spots over abdomen.

Oct. 19.—General condition improved, but there were marked drowsiness and apathy.

Urine: 1.012, albumin trace, casts decreased in number.

Oct. 20.—Patient more somnolent. Vomiting ceased. Tongue heavily coated in center with margin red. Lips dry. On abdomen six to eight small, red, hyperemic macules. Spleen not palpable. Agglutination with B. typhosus one hour 1:40 negative; with B. paratyphosus B, positive.

During the succeeding ten days the patient was at times irrational. Some tenderness over the region of the gall-bladder.

Nov. 2.—Temperature falling by lysis. High point on this date 99.2 F. Appetite good; no nausea. Abdomen soft, but some tenderness at the right costal margin.

Nov. 4.—Patient complained of sudden, severe pain in the right lower quadrant. When seen a few minutes later, she was tossing restlessly in bed. Pulse 118. Temperature 98.6 F. Leukocytes 6,400. After a few minutes the pain lessened, but recurred for brief periods at intervals throughout the day. No signs of local inflammation. Temperature remained normal, and leukocytes were not increased. The patient was irrational at times.

Nov. 8.—A slow improvement in mental condition. Urination involuntary for the past five days. An erythema with severe itching present over arms, legs, and abdomen for the past four days.

Nov. 11.—Blood: Erythrocytes 4,200,000; leukocytes 9,000; hemoglobin 72 percent (Dare).

Nov. 26.—Convalescence rapid. Some tachycardia on exertion, with a coarse tremor of the hands, and a slight increase in size of the thyroid. General condition good.

Blood: Erythrocytes 5,100,000; leukocytes 7,100; hemoglobin 85 percent (Dare).

May 22, 1913.—The patient had been in apparently good health, with the exception of an occasional, slight pain below the right costal margin. At 4 a. m. she was awakened by a sharp, cramp-like pain in the epigastrium, which became very severe; some nausea. After one-half hour the pain became less. A chill lasting several minutes followed. Temperature normal. This attack was very similar to those occurring eight months previously and did not follow any indiscretion in diet. No jaundice. Leukocytes 11,000. Agglutination with *B. paratyphosus B.* one hour 1:50 positive; 1:100, negative.

Jan. 13, 1914.—Following recurrences of the attacks of pain in the right hypochondrium in July, 1913, and again in January, 1914, drainage of the gall-bladder was performed by Dr. Dean D. Lewis. The wall of the gall-bladder was much thickened and contained dark bile. There were no calculi in the gall-bladder or in the ducts. The patient made a good recovery from the operation, and has had no return of the symptoms.

SUMMARY

The onset of illness presented several puzzling features which left the diagnosis in doubt for the first few days. The earlier attacks of epigastric pain seemed clearly referable to the gall-bladder, but the severe attack followed by fever, leukocytosis, and prostration raised the question of an acute condition calling for surgical treatment, such as suppurative cholecystitis or perforation of a duodenal ulcer. After the subsidence of the acute upper abdominal symptoms, the appearance of albumin, red cells, leukocytes, and numerous casts, associated with continued fever, recalled the occasional onset of typhoid fever with acute renal symptoms. *B. paratyphosus B.* was isolated from the blood drawn on the fifth day of acute illness, and agglutination with a laboratory strain of *B. paratyphosus B.* was obtained on the tenth day.

The subsequent course was that of a severe typhoid, with continued fever ranging from 103 F. to 105 F., falling gradually in the fourth week. The pulse was more rapid (110-120) than usual in typhoid during the first weeks of the illness. In the fifth week, a pronounced psychosis developed, and lasted several days with delusions, more marked toward night. At the same time, erythematous, itching lesions appeared over arms, abdomen, and legs, persisting for a week, and during this period there was a recurrence of epigastric pain similar to attacks noted at the onset of the illness, but without leukocytosis or fever. During the subsequent weeks of convalescence, the pulse was irritable, rising on slight exertion, and a slight, temporary enlargement of the thyroid was noted. The later convalescence was uneventful.

A careful search was made for the source of infection. The patient had not received prophylactic typhoid inoculation. She had assisted in tubbing a man suffering from typhoid fever during the weeks previous to her illness. The blood of this man had given prompt agglutination with *B. typhosus*. A detailed examination of persons handling the food supply in the hospital where she was employed as nurse, made somewhat later for another purpose, showed no evidence of infection by *B. paratyphosus B*. It is possible that infection may have occurred through an undetected paratyphoid carrier, among the ward patients, or from a source outside the hospital, but we could obtain no positive evidence on this point.

These investigations were made in the hope of throwing some light on the question of whether we were dealing with an acute, recent infection with *B. paratyphosus B* in a person already suffering from recurrent cholecystitis over a period of five weeks, or whether the cholecystitis was an early manifestation of the infection which later became general. The close association of the two periods of illness, and the later development of the carrier state, with the demonstration of *B. paratyphosus B* in the gall-bladder are suggestive, but the evidence hardly warrants a definite conclusion as to the relation of the two illnesses.

BACTERIAL EXAMINATION *

A bacillus of the *B. paratyphosus* type was isolated uniformly from this patient. The bacillus is gram-negative, actively motile, does not liquefy gelatin, produces gas in dextrose broth, and forms alkali in litmus milk. It produces no indol. Acid and gas are formed in the following carbohydrate media: dulcitol, mannitol, galactose, sorbitol, arabinose, levulose, maltose, mannitol, xylose, and isodulcitol, but not in lactose, saccharose, salicin, raffinose, inulin, dextrin, glycerin, erythritol, and adonitol.

The serum of a rabbit immunized with a typical culture of *B. paratyphosus B* (from the collection of the Museum of Natural History, New York, originally obtained from the Rockefeller Institute) agglutinated this organism (titer 1:2000) as completely as the homologous strain. Controls with *Bacillus typhosus* serum and *Bacillus enteritidis* (Gärtner) serum were negative.

* A portion of the expense for this examination was borne by the Serum Division of the Memorial Institute for Infectious Diseases.

Strains with all the characteristics mentioned were obtained in this case as follows:

Source	Date	Bacillus Paratyphosus B Isolated
Blood	10-17-1912	(Pure culture)
Feces	10-22	—
Feces	11- 5	(Mostly <i>B. coli</i> , very few <i>B. paratyphosus B</i>)
Feces	11-19	(About $\frac{1}{3}$ <i>B. paratyphosus</i>)
Feces	11-26	—
Feces	11-24-1913	(About $\frac{1}{3}$ <i>B. paratyphosus</i>)
Urine	11-24	—
Bile (at operation)	1-13-1914	(Pure culture)
Feces	5-25	—
Feces	6- 1	—
Feces	6-17	—
Feces	11-12	—
Feces	11-21	—
Feces	11-25	—
Feces	12- 3	—
Feces	12- 9	—
Feces	1-27-1915	—
Feces	2- 3	—
Feces	2-11	—
Feces	5- 3	—
Feces*	6-15	—

* Obtained after administration of a purgative.

On May 3, 1915, the agglutinative power of the blood was found to be positive for *B. paratyphosus B* in 1:200 dilution and negative for *B. typhosus* at 1:50.

In each case where successful isolation is noted, several strains of the organism were obtained, and all these resembled one another in every respect. The fermentation reactions of all the strains were identical also with those of the *B. paratyphosus B* cultures (Rockefeller Institute) used for immunizing the rabbit, and with the other laboratory stock strains of the University of Chicago collection labeled *B. paratyphosus B*.

The apparent disappearance of the paratyphoid bacillus from the stools after drainage of the gall-bladder is of particular interest as bearing on the treatment of chronic typhoid and paratyphoid carriers. Operative procedure has been advocated especially by Dehler,¹ who found in his observation of four typhoid carriers that cholecystectomy was followed by practical disappearance of typhoid bacilli from the stools. In one of the cases reported by Dehler, thirty-seven examinations of the feces during the two years before operation resulted in finding *B. typhosus* abundantly every time, while in the first six months after operation seventy-six examinations showed the presence of *B. typhosus* but once and then in small numbers. Similar observations

1. München. med. Wchnschr., 1907, 54, pp. 779-2134; *ibid.*, 1912, 59, p. 857.

have been made by Blumenthal and Grimme,² Daeschler,³ Leary,⁴ O. Mayer,⁵ and others, but in some of these cases, examination of the feces was continued for only a few weeks after operation. It is evident from other observations that drainage or extirpation of the gall-bladder is not always effective in causing the permanent disappearance of typhoid bacilli from the stools. In the instance described by Loele,⁶ the typhoid bacilli found in the feces apparently did not come from the gall-bladder but from the bile duct or diverticula of the upper intestine, as indicated by the autopsy. Fromme⁷ found typhoid bacilli in the liver five days after extirpation of the gall-bladder, and in another case, after removal of an infected gall-bladder, isolated them for some days from the drainage tube in almost pure culture, and concludes therefore that the gall-bladder is not the only seat of vegetation. O. Mayer,⁸ altho noting the disappearance of typhoid bacilli from the stools after extirpation of the gall-bladder, does not believe that this disappearance is lasting in all cases and quotes the expression of Messerschmidt to the effect that after a time typhoid bacilli are again found.

Gall-bladder infections with *B. paratyphosus B* have been recorded by Forster and Kayser,⁹ Lorey,¹⁰ Eckersdorff,¹¹ Evers and Mühlens,¹² and Pribram.¹³ In the case described by Forster and Kayser, *B. paratyphosus* was isolated from the gall-bladder at autopsy; in Eckersdorff's case, the existence of cholecystitis was determined on clinical grounds and a paratyphoid bacillus—agglutinating like the Schottmüller strain—was isolated from the feces. Neither case was submitted to operation.

Lorey's case was one of operation (cholecystectomy) after typhoid (?) of two years' standing, following which "several" examinations failed to show paratyphoid bacilli in the feces, altho these organisms were present before operation. The case reported by Evers and Mühlens was more carefully studied; during the six weeks following operation for gallstones (cholecystotomy), *B. paratyphosus B* was iso-

2. München. med. Wehnschr., 1908, 55, p. 16; Deutsch. Arch. f. klin. Med., 1906, 88, p. 509.

3. Centralbl. f. Bakteriöl., I. O., 1912, 52, p. 283.

4. Jour. Am. Med. Assn., 1913, 60, p. 1293.

5. München. med. Wehnschr., 1914, 61, p. 1116.

6. Deutsch. med. Wehnschr., 1909, 35, p. 1429.

7. Deutsch. Ztschr. f. Chir., 1910, 107, p. 578.

8. München. med. Wehnschr., 1914, 61, p. 1116.

9. Ibid., 1905, 52, p. 1473.

10. Ibid., 1908, 55, p. 15.

11. Arb. a. d. k. Inst. f. exper. Therap. zu Frankfurt, 1908, 4, p. 61.

12. Deutsch. militärärzt. Ztschr., 1909, 38, p. 366.

13. Wien. klin. Wehnschr., 1912, 25, p. 1344.

lated from the feces in four out of eight examinations, and there was no evidence that the operation was successful in removing the patient from the ranks of carriers. Pribram describes an especially interesting case in which a patient was found to be excreting paratyphoid bacilli three years after removal of the gall-bladder.

The case here described is noteworthy for the occurrence of general paratyphoid infection in a person who for a month previously had suffered from recurrent attacks of cholecystitis; for the recurrence of the cholecystitis after convalescence, associated with persistence of paratyphoid bacilli in the stools; for the isolation of the bacilli from the bile at operation; and for complete cessation of gall-bladder symptoms accompanied by disappearance of paratyphoid bacilli from the stools during more than one year following operation (cholecystotomy). During the latter part of the acute illness, no clinical difference could be noted between the infection and a rather severe attack of typhoid fever, and a correct diagnosis could be made only as the result of bacteriologic examination. At no time was there any evidence that this carrier was giving rise to contact cases.